SOME OBSERVATIONS ON

LEAD PARALYSIS

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LEAD PARALYSIS.

Anatomical and Physiological Survey:

The superficial layer of muscles situated on the extensor aspect of the forearm concerned in wrist drop are:

(1) Extensor carpi radialis longior which arises from the lower third of the external supracondylar ridge of the humerus, from the front of the contiguous intermuscular septum, and from the septum between it and the next muscle. It lies on the short radial extensor, is partly covered by the supinator longus, and its tendon passes beneath the extensors of the thumb and annular ligament to be inserted into the base of the metacarpal bone of the index finger.

It extends the wrist, abducts the hand, and can flex the elbow joint.

(2) Extensor carpi radialis brevior.

This muscle is attached to the outer condyle of the humerus by a tendon common to it and the three following/

following muscles, viz., common extensors of the fingers, extensor of the little finger, and ulnar extensor of the wrist; it arises also from the external lateral ligament of the elbow joint.

The tendon of the muscle is closely applied to the preceding, and after passing with it through the same compartment of the annular ligament, is inserted into the base of the metacarpal bone of the middle finger.

It also extends the wrist, abducts the hand, and can bend the elbow joint.

(3) Extensor communis digitorum is single at its origin, but is divided below into four tendons.

It arises from the common tendon, the fascia and from aponeurotic septa between it and the adjacent muscles. The muscle ends at the lower part of the forearm in four tendons, which pass through a compartment of the annular ligament with the extensor indicis, and are directed along the back of the hand to their insertion into the second and third phalanges of the fingers. This is accomplished by means of the common extensor expansion which divides on the dorsum of the lower part of the third phalanx into three parts:-

The central one is fixed into the base of the second/

second phalanx, while the lateral pieces unite and are inserted into the base of the last phalanx.

On the fore and little fingers the expansion is joined by the special tendons of those digits.

The muscle straightens the fingers and separates them from each other, acting especially on the first phalanges. The digits being straightened, it will assist the other muscles in extending the wrist and elbow.

(4) Extensor minimi digiti is the most slender muscle on the back of the forearm and appears to be but a part of the common extensor. It arises in common with the extensor communis, but passes through a distinct sheath of the annular ligament.

Beyond the ligament the tendon splits into two, and the outer part is joined by the fourth tendon of the common extensor; both parts eventually enter the common expansion on the first phalanx of the little finger.

The muscle extends the little finger and moves back the wrist and elbow. It can also straighten the digit during flexion of the other fingers.

(5) Extensor carpi ulnaris arises from the common tendon, aponeurosis of the forearm and external/

external intermuscular septum, it is fixed also by fascia to the middle third of the posterior border of the ulna. Its tendon passes through a separate sheath in the annular ligament, and is inserted into the tuberosity at the base of the metacarpal bone of the little finger. The muscle extends the wrist, and inclines the hand towards the ulnar side; it can then extend the elbow-joint.

The deep layer of muscles comprise:

(1) Extensor ossis metacarpi pollicis: This is the largest and highest of the extensor muscles of the thumb.

It arises from the posterior surface of the radius in its middle third, from a special narrow impression on the ulna, occupying the upper third of the outer division of the posterior surface, and from the intervening interosseous membrane.

The tendon is directed outwards over the radial extensors of the wrist, and through the annular ligament to be inserted into the base of the metacarpal bone of the thumb, and by a slip into the trapezium.

Its action is one of carrying the thumb outwards/

wards and backwards from the palm of the hand, and of moving the hand to the radial side.

(2) Extensor brevis pollicis, which is the smallest muscle of the deep layer; its tendon accompanies that of the preceding extensor. The origin is from the radius and interosseous membrane close below the attachment of the last muscle. The tendon passes through the same space in the annular ligament as the extensor ossis metacarpi pollicis, and is inserted into the base of the first phalanx of the thumb. This muscle extends the proximal phalanx, and then the metacarpal bone.

(3) Extensor longus pollicis arises from the middle third or more of the ulna, along the ulnar side of the extensor of the metacarpal bone; and from the interosseous membrane below, for about one inch. Its tendon passing through a distinct sheath in the annular ligament is directed along the dorsum of the thumb to be inserted into the base of the last phalanx. It acts by first extending both phalanges of the thumb, and then helps to move backwards the metacarpal bone and the hand.

(4) Extensor Indicis: arises on the inner side/

side of the extensor longus pollicis from the ulna for three or four inches, usually below the middle, and from the lower part of the interosseous membrane.

The tendon passes beneath the annular ligament with the extensor communis digitorum, and blends with the external tendon of that muscle in the expansion on the first phalanx of the fore finger.

The muscle acts by pointing the fore finger and helps the common extensor of the fingers in extending the wrist.

All the muscles, with the exception of the extensor carpi radialis longior, are supplied by the posterior interosseous nerve, which, arising from the trunk of the musculo-spiral nerve, winds backwards through the fibres of the supinator brevis. It then runs between the superficial and deep layers of muscles as far as the middle of the forearm, and sinking beneath the extensor of the second phalanx of the thumb runs on the interosseous membrane to the back of the carpus, where it terminates in filaments to the articulations.

The other motor nerve for this part is the musculo-spiral/

musculo-spiral nerve, which is the largest trunk of the posterior cord of the brachial plexus (formed by the sixth, seventh, and eighth cervical nerves.)

In the upper arm it winds with the superior profunda artery beneath the triceps muscle. At the outer aspect of the arm it is continued between the brachialis anticus and supinator longus muscles to the external condyle of the humerus, in front of which it divides into the radial and posterior interosseous nerves. Its muscular branches go to all three heads of the triceps, anconeus, supinator longus and extensor carpi radialis longior. From the fact that the three former muscles are supplied by the musculo-spiral nerve (although not in any way affecting the wrist joint) they must be considered. (The extensor carpi radialis longior has already been mentioned.)

(1) Triceps muscle is divided superiorly into three heads of origin - inner, outer and middle.

The middle or long head has a tendinous origin, about an inch wide from a rough mark on the axillary margin of the scapula, close to the glenoid cavity, where it is united with the capsule of the shoulder joint/

joint. The outer head is narrow, and arises from the back of the humerus, extending from the root of the large tuberosity to the spiral groove.

The inner head, arises from the posterior surface of the humerus below the spiral groove. Inferiorly the muscle, by union of the different fibres, is inserted into the end of the olecranon process of the ulna, and gives an expansion to the aponeurosis of the forearm. The action is one of extension of the elbow joint.

The long head can depress the raised humerus, and abduct the arm.

(2) Supinator Longus arises from the upper two-thirds of the external supracondylar ridge of the humerus, and from the front of the external intermuscular septum of the arm. It is inserted into the lower end of the radius just above the styloid process.

The action is to flex the elbow-joint, and if the radius is forcibly pronated or supinated to put the hand into an intermediate position between pronation or supination

(3) Anconeus is a small triangular muscle near the elbow, and arises from the outer condyle of the/

the humerus. It is inserted into the outer side of the olecranon, and into the impression on the upper third of the posterior surface of the ulna.

The muscle aids the triceps in extending the elbow.

(4) Supinator Brevis (No action on the wrist joint, but supplied by the posterior interosseous nerve) surrounds the upper part of the radius, except at the tuberosity, and the front of the bone below it. It arises from the external margin of the ulna for a distance of two inches, from a depression below the small sigmoid cavity, and from the orbicular ligament of the radius and the external lateral ligament of the elbow joint. It is inserted into the upper third of the radius, except at the fore and inner parts, reaching downwards to the insertion of the pronator teres, and forward to the oblique line of the bone. When the radius has been moved over the ulna in pronation, the short supinator brings that bone again to the outer side of the ulna.

The cutaneous supply of the forearm:

The musculo-spiral nerve supplies cutaneously the/

the radial side of the forearm and hand by means of

(1) The internal cutaneous branch which, arising in the axillary space is common with the branch to the inner head of the triceps, is directed across the posterior boundary of the axilla to the inner side of the arm, where it becomes cutaneous in the upper third, winds to the back of the arm and reaching the olecranon is promulgated for a short distance below this. It supplies the integuments over the triceps and anconeus.

(2) The external cutaneous branches. These are two in number, and appear at the outer side of the limb about the middle. The upper one turns forwards and reaches the front of the elbow, supplying the anterior part of the arm. The lower branch pierces the fascia further down, and, after supplying some cutaneous filaments to the back of the arm, is continued to the forearm where it ends in the skin over the supinator longus and extensor carpi radialis longior.

(3) The Radial nerve ramifies in the integument of the back of the hand and some of the digits. It/

It becomes cutaneous at the outer border of the forearm in the lower third, and after giving some filaments to the posterior aspect of the limb, divides into two branches:-

One (external) is joined by the musculo-cutaneous nerve, and is distributed on the radial border and the ball of the thumb.

The other branch supplies the remaining sides of the thumb, both sides of the next two digits, and half the ring finger.

(The remainder of the cutaneous supply is carried out by means of the internal cutaneous, lesser internal cutaneous, musculo-cutaneous, and ulnar nerves on the extensor aspect of the forearm, and through the internal cutaneous, musculo-cutaneous, median and ulnar nerves on the flexor aspect.)

The sensory distribution of the spinal nerve roots are as follows:-

The outer part of the forearm is supplied by the fifth cervical nerve root; the central portion of the posterior aspect of forearm, along with the thumb, index, middle and ring fingers, by the sixth and seventh cervical nerve roots; the inner side of the little finger, hand and forearm by/

by the eighth cervical nerve root, and the inner side of the forearm by the first dorsal nerve root.

The motor segmental functions of the cervical enlargement concerned are as follows:-

The extensors of the wrist and long extensors of the fingers, from the seventh cervical nerve root.

The reflex arc for the elbow and wrist jerk pass through the sixth cervical segment.

For the production of the ciliospinal reflex, the fifth, sixth, seventh, eighth cervical and first dorsal nerve roots are involved

For the scapular reflex, the sixth, seventh, eighth cervical and first dorsal nerve roots come into action, and for the palmar reflex, the seventh, eighth cervical and first dorsal nerve roots.

ETIOLOGY OF INDUSTRIAL LEAD POISONING.

Lead enters into the body more especially by way of the alimentary system, through eating with unwashed hands in the workshop, and also from swallowing saliva impregnated with "lead dust".

Another and an equally important route is through the respiratory system, when the dust is inhaled floating in minute particles in the air, and/

and also that which has become adherent to the clothes of the lead worker. Perhaps a less common way is solution of dust in the sweat and absorption by the skin.

The Salts of Lead causing Poisoning:

All lead salts are more or less poisonous, and these are more likely to produce toxic symptoms from the entrance of minute quantities through a lengthened period than one or two doses in a large amount. In the Potteries, lead oxides or carbonates and the fritted mono- or bisilicates are the usual forms.

The sulphide and chromate of lead may be regarded as the most insoluble salts, the sulphate nearly equally so.

Metallic lead is not so dangerous as its salts. If entering by the respiratory passages, the metal or its salts are converted by the alkaline secretions on the respiratory passages into the carbonate, and then into the more soluble bicarbonate. Should the poison gain entrance through the stomach, the hydrochloric acid of the gastric juice converts it into the soluble chloride.

Oliver clearly proved by experiment that the gastric hydrochloric acid converted the insoluble lead/

lead carbonate, which is the salt most usually absorbed, into the soluble lead chloride, and that the presence of pepsin or proteids in gastric digestion reduced considerably the amount of lead dissolved, the union of proteid with the lead chloride either forming an insoluble albuminate, or that the hydrochloric acid being used up in the conversion of peptone, the lead carbonate being insoluble would pass out of the stomach with the chyme. He also found that both bile and pancreatic digestions dissolved more lead than even gastric digestion, but that the presence of fat with the lead materially prevented its solution.

From these facts it is most evident that no lead workers should go to work on an empty stomach. The amount of lead absorbed is small; what amount that is taken into the system is eliminated by the kidneys and skin, the insoluble compounds being thrown out by the faeces.

After the action of gastric juice upon lead, the soluble chloride enters the blood, which containing sodium chloride, still further increases its solubility and thus is excreted by the kidneys.

The lead salts in solution act as a chemical irritant/

irritant on the nerves generally in the body, but have elective affinities for particular nerves, most cqmmonly those supplying muscles situated on the extensor aspect of the forearm, and very rarely those supplying the extensor muscles situated on the front of the leg.

LEAD PARALYSIS.

In the production of this condition, the element of fatigue seems to me to take an important part.

From a comparison of the following cases, it will be seen that that arm that had the hardest work to do was primarily and most seriously affected.

Case I.

Ellen D., by occupation a tile scraper. In this she was constantly scraping the tiles with a knife in her right hand; whilst thus working she kept her right hand constantly cramped, not relaxing her hand muscles for an hour or two at a time, and her wrist was constantly undergoing flexion and extension. Her left hand, though being used/

used, was allowed some rest between the picking up of each consecutive tile. In her case the right arm was primarily affected, and remained permanently the worse of the two.

Case II.

Ernest F., a majolica kiln placer. His work was to fetch the tiles from the dipper and place them in the majolica kilns. In so doing the right hand was more used than the left, and consequently became sooner fatigued.

The fingers of the right hand were the first to show signs of dropping, and after treatment recovered last, proving that the paralysis on the right side was more profound.

Case III.

Joseph B. Was a ware-carrier. He carried the ware to the dippers on his head in a basket, the right arm supporting it in that position. He also washed some boards with a sponge. Here the right arm was used for all his work, and the left remained free.

In this case, the right arm only was affected.

Case IV.

Elizabeth H. Her work was a ground layer. The/

The ware was supported by the left hand, while the "Pencil" was being constantly applied with the right. In this way the left hand had less work to do than the right, which was primarily and more seriously affected.

In muscles having undergone much exertion, there is absorption into the blood of waste products that temporarily poison the system. These act upon the nerve endings in muscle and temporarily paralyse them, due to the nutrition of the nerve fibres being lowered, and therefore they are unable to resist the absorption of poisonous products introduced from without.

Since in lead poisoning metabolism is so much arfected, and the action of the emunctory organs, liver, kidneys, skin and bowels, is imperfectly performed, is it not possible that the toxic products of lead circulating in the blood act in this way on the nerve endings of fatigued muscles, and permanently paralyse them?

In the first case, the poison is produced within the system; in the second, the toxic agent is introduced from without, and would seem to act more powerfully on muscles whose nutrition has been lowered/

lowered by fatigue. It seems likely that at the end of a hard day's work in some lead occupation that absorption of lead is more probable than at the commencement of the day, when the tissues are invigorated, and that therefore the element of fatigue may be a factor in the production of such poisoning, by acting as a predisposing cause to the toxic effect of lead.

The fact that women are more susceptible than men to the poison and so to the paralysis, may be due partly to the presence of their inferior muscular development, and consequently fatigue is more readily produced, the muscles at the same time losing their tone, due to want of trophic influence, which cannot be supplied from the chronically inflamed nerves.

No doubt another potent cause is that excretion in women is not so perfectly performed, and also the irregularity of menstruation (amenorrhoea) which is usually present may exert an influence.

Morbid Anatomy:

In lead paralysis the brain is almost invariably found healthy. Only occasionally has the spinal cord been found to be involved by Oeller, Romberg, Erb/

Erb and Monakow.

In Oeller's case, extensive capillary apoplexies were found from medulla to cervical enlargement, with consequent foci of softening in the anterior horns of grey matter. The ganglion cells were markedly atrophic. In the Aran-Duchenne type, where atrophy is the conspicuous feature, there is degeneration of the ganglion cells of the anterior horns.

The most marked and constant changes occur in the muscles and nerves.

The Muscles : To the naked eye in the early stages of atrophy the muscular tissue is seen to be pale, while where atrophic changes are advanced, these are marked by a yellowish appearance.

Microscopically, the muscular cylinders are seen to be diminished in diameter, transverse striation of the fibres are less distinct, and many are granular. Hyaline degeneration is present if there is no regeneration of tissue.

Interstitial cirrhosis occurs between the muscular fibres leading to their atrophy and shortening. The vessels, especially the arteries, are thickened, showing both endo- and periarteritis.

The/

The Nerves: The changes are most marked here and are seen in the intramuscular twigs especially. They are less noticeable the nearer to the cord. The trunks of the nerves are not free, and degeneration is seen in patches.

The condition is one of a parenchymatous neuritis, analogous to Wallerian degeneration, namely segmentation of myelin, with breaking up and disappearance of the axis cylinder, with proliferation of the nuclei and protoplasm of the sheath.

In the "periaxial neuritis" of Goumbault, where the changes are slighter, the axis cylinder is preserved, but the myelin breaks up and the nuclei of the sheath proliferate.

The neuritis is here segmentary, affecting several of the annular segments of Ranvier.

From the fact that the axis cylinder is spared (thus differing from the Wallerian degeneration which follows section of a nerve) explains the reason why recovery from paralysis is usually rapid in the pseudo-general paralysis associated with the Saturnine form. If so, the segmentary neuritis may either be a true neuritis or simply a myelino-neuritis as in disseminated sclerosis.

Pathology/

Pathology:

In all probability lead poisoning is due to the primary poisonous action of lead on the eliminating organs (liver and kidneys); these become unable to perform their function, and there is consequently a retention of secondary poisons in the blood.

The irritant acts on the whole nerves at once; the neuritis is therefore multiple and symmetrical, but shows elective affinity for the posterior interosseous branch of the musculo-spiral nerve. The motor fibres are more affected than the sensory.

Groups of muscles functionally related are attacked; these retain their galvanic irritability, and do not react to Faradism; the nerve supplying them reacts to neither stimulus.

The right upper limb is more frequently involved than the left.

The question of fatigue again arises as a predisposing cause, the right hand is undoubtedly more used.

Another suggestion occurs that the left side of the brain being more highly developed (proved by the presence of the various centres for special sense) may be more susceptible to any adverse influence/

fluence; the same argument may hold good for hemichorea where, in the large majority of cases, the right side of the body is involved.

The question as to whether the lesion is peripheral or central still remains much discussed.

Oliver suggests that the ganglion cells in the cord are primarily affected, and secondarily the peripheral terminations of the nerves, which are the most easily involved on account of their distance from the trophic centres, and consequently are more vulnerable to the toxic blood. He adds that many cases of saturnine peripheral neuritis can only be explained by stating that the lesion is a combination of both peripheral and central.

Where no pathological changes are found in the ganglion cells of the anterior horns, there may be dynamic conditions involving the central cells which may affect the peripheral terminations.

The theory that the lesion is central seems to me to receive support from the fact of the occurrence of encephalopathy in certain cases, while where the poisoning is acute and the paralysis is rapid, no pathological changes being found, comparison may be drawn to that variety of bulbar paralysis without anatomical change, where in all probability some/

some toxic products are not properly excreted, which paralyse the most vulnerable point of the voluntary neuro-motor mechanism, namely the motor end plates.

It is generally believed now that the lesion is distinctly peripheral, and evidence has gone to prove that the nerve is primarily affected, though in acute cases of lead-poisoning no change is found in the peripheral nerves. Against that part of the neuropathic theory that claims the intra-muscular twigs as being primarily affected and consequently the nerve trunk atrophying in an ascending manner, is the fact that the motor fibres of the trunk being most affected are descending nerves, whilst the sensory fibres, acting in an ascending manner are not so commonly involved. The myopathic theory, after demonstration by Heubel, that the muscles of all tissues of the body, with equal weights of material, contain the smallest amount of lead, is difficult to support.

It is quite evident that the muscle first recovers because of reaction to electrical stimulation before nerve, and from the fact that should wrists with complete drop be placed upon an anterior splint for a few days, there is an appreciable increase of extensory movement at the joint, in all probability/

probability due to the fact that the extensor muscles no longer working against the contracted flexors have rapidly recovered tone. This may be explained because muscle is more vascular than nerve, and so regeneration of tissue can be more easily accomplished.

Symptoms:

"Nearly all cases of lead paralysis are preceded by other symptoms of saturnine poisoning, the commonest being attacks of severe headache, persistent vomiting after food, colic, a chronic state of constipation, marked anaemia, and the presence of a bluish black line at the junction of teeth and gums. Local sensory phenomena as an early manifestation, are very commonly experienced, and these seem to be more frequently present than is usually supposed.

In only one case out of ten examined were these found to be absent. Their nature varies considerably. Some complain of sharp shooting pains along the course of the nerves, and almost invariably these are succeeded, when the paralysis becomes evident, by sensations of numbness, tingling or/

or dull aching. At a still later stage to this, the skin is usually found markedly anaesthetic or hyperaesthetic. It seems those that suffer most from prodromal sensations lose eventually their sensibility to touch and pain more than those in whom these symptoms are not so marked.

Other sensory phenomena, though not so common as the first mentioned variety, embrace such feelings as waves of heat or cold passing over the limbs, and occasionally formication.

The resulting paralysis is usually bilateral and symmetrical but, as before stated, the right arm is more often involved.

The extensor muscles of the wrist and fingers are most commonly attacked, less commonly other groups of muscles suffer, whilst very rarely the paralysis is more general, and nearly every muscle of the body is involved. The flexors of the fingers, while weakened, are not paralysed.

Usually paralysis develops subacutely, the patient noticing increasing difficulty with certain movements; sometimes the onset is acute, at other times very slow.

Atrophy of all paralysed muscles is most marked; reaction of degeneration to electricity is/

is concomitant. In the antibrachial type, some of the paralysed muscles do not react to the faradic current, others do so slightly, and in some cases it is found that the area of paralysis is greater than that of altered electrical reactions. The reverse, though, does occasionally occur.

Fine tremors are usually present and are increased by voluntary movement; fibrillary contractions are not so common. These tremors are seen in the affected muscles, but sometimes the movements are generalised.

Alterations in the cutaneous sensibility vary. In some cases it is normal, in others, usually in the early stages, hyperaesthesia is present, while later the patient may show signs of anaethesia and analgesia.

I have noticed that the rate of conduction of a sensory impulse is often delayed.

The local skin and tendon reflexes are of necessity deficient or absent. Vasomotor function is nearly always affected. The hands perspire easily, are often smooth and glossy, and wrinkles or folds in the skin are sometimes absent. The sensations of heat experienced are no doubt due to paralysis of the peripheral terminations of vasomotor nerves.

The presence of a diffuse swelling on the dorsal aspect of the hand is not an uncommon condition. This, known as Grubler's tumour, may, consequent on the wrist drop, be due to a stasis of synovial fluid in the distended tendon-sheaths, gravity acting as a deterrent to the flow in an upward direction.

Recovery is generally slow and incomplete.

TYPES OF LEAD PARALYSIS.

(1) The anti-brachial type, or wrist-drop type: This is by far the commonest variety. There is paralysis of the extensors of the fingers and of the wrist.

The supinator longus usually escapes and sometimes the extensor ossis metacarpi pollicis. The extensors of the fingers are not usually equally arfected, and one or other may escape. The right hand is generally involved first; the weakness is shown by inability to extend the first phalanges of the two middle fingers, indicating paralysis of the common extensor of the fingers. The index and little finger follow suit in the same way.

Next/

Next the basal phalanges of the four fingers and then of the thumb become unable to be extended. Finally the extensors of the wrist become paralysed, the hand falls and forms a right angle with the forearm; the fingers become flexed, and the thumb falls into the palm. The flexors appear paretic, but when the hand is raised they can act with vigour.

Atrophy of the posterior aspect of the forearm follows, causing flattening of the part.

(2) The Brachial Type :

Paralysis of the Duchenne-Erb group of muscles, namely, the deltoid, biceps, brachialis anticus, and supinator longus, sometimes the supraspinatus and infraspinatus, rarely the pectoral muscles. This form is usually bilateral and denote a severe case; it commonly follows paralysis of the forearm extensors, but it may be primary. The deltoid and biceps are most frequently affected.

In this type muscular atrophy and disturbance of electrical contractility are not so marked as in the common form. Occasionally the paralysis invades the muscles of respiration (intercostals, diaphragm, and laryngeal muscles) and later those of deglutition; these cases end fatally.

(3) The Aran-Duchenne Type:

Paralysis of muscles forming thenar and hypothenar eminences and interossei. Here the atrophy is most marked and accompanies rather than succeeds loss of power. It may accompany the antibrachial type, or may be primary.

Moebius has shown that these muscles are worst which are preponderatingly used. He noticed this type, especially in file cutters, where, during work, the muscles of the thenar eminence were kept in constant spasm. The element of fatigue may account for this.

(4) The Peroneal Type:

Paralysis of the peroneal muscles, with the extensor communis digitorum and extensor proprius hallucis. The tibialis anticus is usually spared.

This is a rare form and when it occurs accompanies paralysis of the arms or forms part of a general paralysis.

When lead paralysis is met with in children, it is the type then most commonly seen. Sensory phenomena are nearly always present, while atrophy is not pronounced.

In consequence of the paralysis, there is steppage gait.

(5) The Laryngeal Type:

This is very rare, and consists in paralysis of one or both vocal cords, or adductors of the glottis or muscles of the larynx, singly or in groups.

(6) The Pseudo-general paralytic type:

Usually violent delirium or an epileptiform attack ushers this variety in, followed by the ordinary symptoms of delirium tremens.

The common wrist drop type generally precedes this; the paralysis becomes rapidly or slowly generalised, affecting the muscles of respiration, as well as the limbs.

Speech is very disturbed, and the memory is lost; tremors and sensory phenomena are well marked. Recovery is usually rapid, even when the paralysis is most profound.

(7) Oliver has recorded cases of paralysis of the third nerve, also disturbance of bladder function causing either retention or incontinence of urine.

Diagnosis:

This naturally does not rest only on the character/

acter of the paralysis, but on the associated signs of lead poisoning present.

The severe abdominal colic, generally increasd by pressure and more or less unilateral, associated with pain along the course of the vagus on the same side, usually precedes any appearance of paralysis. The history of the case, the presence of a blue line on the gums, distinct cahexia, extreme restlessness, previous constipation and metallic taste in the mouth all point to the cause.

Paralysis is usually bilateral, and from the fact that the muscles of the upper extremity and particularly the extensors of the wrists and fingers are affected rather than those of the lower limb point to saturine rather than arsenical or alcoholic paralysis.

There is less tenderness on pressure of muscles in lead than in alcoholic or arsenical paralysis, and there is said to be greater sensory disturbance and more atrophy in arsenical than in saturine poisoning.

The paralysis is extensor only in lead, whilst in progressive muscular atrophy and anterior poliomyelitis the flexors are also affected. Tremors are less marked than in mercurial poisoning, cease during/

during rest, and are not so remittent.

The extensor communis digitorum is the first muscle to be involved, followed by the other muscles supplied by the musculo-spiral nerve, with the exception of the supinator longus. which usually escapes.

Electrically, the affected muscles respond to galvanic stimulation, while to faradism, they fail to react.

Chemical tests for lead lend a valuable aid in the detection of the metal in the system. As to the time that lead is eliminated in the urine after the first symptoms of acute poisoning have appeared, it still remains an open question, but it has been discovered 25 days afterwards.

Dixon Mann by a series of experiments has proved that the channel through which most of the lead is excreted is the faeces.

To a less extent the metal leaves the system by the urine, and Abram and Marsden's method is the most satisfactory and most delicate test. For this, a strip of magnesium is placed in the urine. Ammonium oxalate, in the proportion of 1 grm. to 150 c.c. is added. If lead is present, it is deposited on the magnesium within half an hour. The slip is then washed with distilled water and dried.

To/

To confirm the test:

(1) Warm the slip with a crystal of iodine upon it - a yellow colour shows the presence of lead.

(2) Dissolve the deposit in nitric acid and divide into two portions. If lead exists, with a solution of Potassium Iodide a yellow colour is obtained with one portion; and with the other if a solution of Potassium Bichromate be added, a similar colour is got.

A Series of four cases illustrating the Antibrachial type of lead poisoning.

Case I., Ellen D., age 24.

Occupation, Tile Scraper.

Duration of Illness, 4 months.

History:

The patient first noticed a month before her wrist trouble began that she used to have very severe shooting pains at night (which kept her awake) in both arms, worse in the right one; also pains in both her ankles, which were not so severe as those in her arms. When her wrists began to drop, then the pains in arms and legs left her.

The drop first began in the middle and ring fingers/

fingers of the right hand, with inability to extend the first phalanges, followed in a week by the remaining fingers and thumb; almost immediately after the wrist dropped.

Whilst this was going on, the left hand commenced in a similar way, and the order of progression of loss of power was the same.

At the same time she had a metallic taste in her mouth, the appetite was very poor, vomiting persistently after food, and the bowels were obstinately constipated. She had colicy pains which lasted for hours at a time, situated at the umbilicus and relieved a little by removing all tight clothing.

Occasionally she had violent headaches, which were situated at the back of the head; her sight, though temporarily dim, was not lost. She did not continue to work after the commencement of these symptoms. All the necessary precautions, such as wearing overalls, bonnets, washing the hands before taking food, were carefully observed.

General Condition of Patient:

She is a strong, well-developed girl, with no appearance of anaemia. Teeth are good, and there is/

is no sign of any blue line. There is considerable pain on pressure over both vagi, especially the right one. Pupils are equal, react normally, colour vision is normal. Ophthalmoscopically, both fundi show no abnormality.

Menstruation normal now, though during the acute stage there was complete amenorrhoea.

Locally:

There is complete double wrist drop. Grubler's tumour present on the right hand. Considerable wasting and flaccidity of all the extensor muscles of the wrist is evident in both arms. The flexors are not wasted, but flaccid. There is complete paralysis of all extensors of the wrist on the right side.

In the left arm, there is slight movement of extension and towards the radial side of the forearm, shewing the extensor carpi radialis longior can act. Some action of the extensor carpi radialis brevior evinced by some extension of the wrist when the fingers were flexed.

No action of the extensors carpi ulnaris.

Supinator longus action in both arms deficient. The patient's hands and forearm perspire very easily, and/

and they feel both very hot and very cold at times. They are smooth and glossy, and no wrinkles or folds in the skin can be seen.

All skin reflexes, scapular, palmar and cilio-spinal are inactive. Albow and wrist jerks are unobtainable.

(Electrical reactions later).

Flexors of wrist. No register with dynamometer with the right hand, with the left, the dynamometer registers 12. Sensory functions. Even now feelings of both hot and cold waves are present at times and the hands amd forearms feel very numb.

Rate of conduction is everywhere delayed.

The aesthesiometer shows on both sides marked deficiency of sensibility to touch, and there is accompanying complete analgesia of the parts, more noticeable on the extensor aspects.

Thermal and muscular senses are normal.

Measurement of the forearm six inches from lower extremity of styloid process of ulna.

Left side = $8\frac{3}{4}$ inches.
Right Side = 9 inches.

No abnormality in lower extremities. The urine shows no albumen and no lead.

Case II., Ernest F., Age 27.

A ghost placer. Duration of illness, 7 weeks. History/

History:

His illness commenced with pains in the lower part of abdomen, which were very severe, and lasted almost continuously for three days. These were relieved temporarily by pressure. At this time he used to vomit nearly all his food, and could only take fluids.

In the mornings on waking he had a disagreeable taste in the mouth, lost his appetite, and the bowels were constipated.

The day after the commencement of his illness, he found that he was unable to lift up the middle and ring fingers of his right hand; this was followed in a few hours by inability to raise his thumb.

Subsequently in a day the same fingers and thumb of the left hand were similarly affected. Prior to this he had had no pains nor numbness in his hands, no headache, nor disturbance of vision.

The patient had had a mild attack of lead poisoning seven years ago.

A sister of his whilst working in "the lead" eight years ago had complete double wrist drop and one sided foot drop, from which she subsequently entirely recovered. No alcoholic history to be obtained.

General/

General condition:

No anaemia is present. There is a faint blue line on both alveolar margins. No neuritis of vagi, or pain on pressure of fore arms.

Pupils and vision are normal. Ophthalmoscopically no change.

Locally:

There is no wrist drop, but persistent flexion of the metacarpo-phalangeal joints of the middle and ring fingers of both hands, more marked in the right.

The thumb of the right hand lies in a straight line with its metacarpal bone and cannot be hyper-extended.

The left thumb feels weak, but all its movements are normal. No paresis of the flexors is present. Considerable tremor of the affected fingers occurs on attempting to extend.

There is slight wasting of the extensor aspect of both forearms.

The action of all extensor muscles is normal. in both arms, with the exception of both extensor communis digitorum, and the extensor ossis metacarpi pollicis, the extensor longus and brevis pollicis

of/

of the right hands. Scapular and palmar reflexes are diminished, while the ciliospinal are normal.

Elbow jerks are normal, while the wrist jerks are normal when the muscles on the inner and outer side of the back of the forearms are tapped.

There is no jerk when the middle of the extensor aspects are stimulated.

The vasomotor system shows derangement by both hands constantly perspiring.

Dynamometrical measurement registers 30 with each hand.

Objective and subjective sensation is normal. Measurement of forearm (3 inches from lower end of styloid process of ulna:

Right = 6 inches.
Left = 6 inches.

Urine contains a trace of albumen, no lead.

Case III., Joseph B., age 42.

Occupation, a dipper. Duration of illness, 4 months.

History:

The patient noticed first of all that he had obstinate constipation, and that he had several attacks of colic, which was relieved by clasping his hands/

hands over the painful area. He used to vomit after every meal and completely lost his appetite.

At times he had severe pains in the head, which shot from one temple to the other. Two or three days after he found he was unable to lift up the two middle fingers of his right hand; his thumb became similarly affected, and was almost immediately followed by complete wrist drop. His left hand remained unaffected.

Whilst having colic, he was troubled with sharp shooting pains, which started high up in the spine and proceeded down his right arm; sometimes these sensations were more of the feeling of pins and needles. He had been engaged in lead works previous to this attack, but though he had been careless as to personal cleanliness, had had no symptoms of poisoning. In this case a distinct history of alcohol was obtained.

General Condition:

There are no signs of cahexia, but a deep blue line is present along the alveolar margins of both upper and lower jaw - no pigmentation of the buccal mucous membrane.

Pressure over the right vagus elicits pain, and there is some tenderness on squeezing the right forearm/

forearm. Pupils are normal.

Locally:

There is ability to bring the right hand into a straight line with the forearm, but hyperextension cannot be performed. The thumb cannot be moved into the extended position.

The index finger can be partially, but not wholly extended, the little finger is unaffected, while the middle and ring fingers cannot be moved out of their flexed position.

Supinator longus is not so powerful as the same muscle in the left arm.

There is some loss of power in the extensor carpi ulnaris and extensor carpi radialis longior and brevior. The extensor communis digitorum is still weaker, while all the extensors of the thumb are powerless. The extensor indicis is partially out of action, but the extensor minimi digiti acts normally.

Muscles on the back of the forearm are all wasted, while there is some flaccidity of muscles on the thenar and hypothenar eminences. Interossei are normal. Fine and intrafibrillary tremors are evident on voluntary movement. Flexors are slightly paretic. Grubler's tumour is present.

Scapular/

Scapular, palmar and ciliospinal reflexes are diminished, elbow and wrist jerks likewise. Vasomotor disturbance evinced by feelings of heat and cold at different times.

Action of flexors. Dynamometer reads 30 with left and 10 with right.

The patient has considerable pain on grasping the forearm. Pain is normally experienced on the hand. Rate of conduction is delayed. Aesthesiometer shows deficient sensibility to touch. Measurement of forearm, 6 inches from styloid process of ulna:

Right = $7\frac{3}{4}$ inches.
Left = $8\frac{1}{2}$ inches.

There is no albumen in the urine, nor lead.

Case IV., Elizabeth H. Age 53:

A ground layer. Duration of illness, 1 month.

History:

The patient bagen at first to vomit after food, nothing could be retained on the stomach. This was accompanied by boring pain in the middle of the lower portion of the abdomen, which left her at times.

This lasted four days; the pain was partially relieved/

relieved by the application of hot salt bags. The sweet taste in her mouth was most objectionable, and the bowels were costive.

These symptoms soon improved, but with their disappearance she found she lost all the use of her right hand, and could hold nothing in it.

The middle, ring and little fingers of the right hand were first affected and soon after the wrist dropped. The same thing happened in the course of a few days to her left hand.

Before the hands became affected, she had shooting pains, at other times a dull aching from the shoulders down to the finger ends; these were most noticeable the first thing on waking.

When these pains disappeared, they left a numbness always present.

She had at the same time neuralgic pains in both temples, which kept her awake at nights, also shooting pains down the legs.

She walked with difficulty, and had to be fetched home at nights. Her eyesight became deficient, saw double now and then, and had a constant soughing in her ears.

The patient was careful with the necessary precautions/

cautions, and habits as to food and drink were satisfactory.

General Condition:

The patient is the subject of a profound cahexia. Appetite is poor, no blue line present. Right pupil is contracted, both react normally. Slight pressure on both vagi elicit some pain. Ophthalmoscopically, no signs of any neuro-retinitis.

Locally:

Great loss of power in both hands is evident. The dynamometer registers 12 in each hand. The fingers are drawn into the palms. There is general wasting and flaccidity. On voluntary movement tremor is most marked. Both wrists can be extended, but not hyperextended.

Right Hand:

There is slight extensile movement in the thumb, none in any other of the fingers at the metacarpo-phalangeal joints.

The extensor carpi radialis longior and brevior act feebly. Extensor carpi ulnaris is normal.

Left Hand:

No extensile movement of the little, ring, and middle/

middle fingers, slight extension in the index finger possible, and a little more still in the thumb at the metacarpo-phalangeal joints.

Both extensor carpi radialis longior and ulnaris act well. Skin and tendon reflexes are all absent. Both hands and forearms, especially the fingers, are numb at all times. Sensibility to touch deficient, while sensibility to pain is most marked.

Measurement of forearms four inches from the styloid process of the ulna is 6 inches in each case.

There is some loss of motor power in the legs - no paralysis of extensors. Patellar and plantar reflexes are lost. Electrical reactions are normal. Some hyperaesthesia of the skin on the extensor aspect of the legs is present. Urine contains a trace of albumen, but no lead.

THE TREATMENT OF LEAD PARALYSIS

BY ELECTRICITY.

Firstly as to the therapeutics of electricity

(1) Stimulating and trophic effects:

It acts as a stimulus to muscular tissue directly and indirectly to it through the motor nerves, through the sensory nerves it favourably influences the/

the central nervous system. It aids the vasomotor system.

By stimulating the tissues generally to activity they are able to eliminate any harmful products in the system, and afterwards electricity rebuilds and regenerates the diseased tissues.

(2) Electrolytic effects:

These cause the elimination of the metal from the system, which is probably excreted as a chloride, and should the electric bath be employed, can sometimes be discovered at the poles. The amount of lead in the tissues probably amounts only to a few grains, and the quantity deposited on the electrodes could, in a bath of ordinary strength and duration, only be counted in milligrammes.

Lewis Jones remarks that contrary to the usual rule in electrolysis, lead is deposited at the positive pole as peroxide, which rapidly chan ges in the presence of chlorides, and also at the negative pole in metallic form.

(3) Electrotonic effects:

With the constant current in the early stages of lead neuritis, where there is much local pain, the sedative effect of the anode is of service, whilst later the increased irritability of Kathelectrotonus by/

by application of the negative electrode to the paralysed muscles aids their recovery.

(4) The action on paralysed muscles:

Any electrical application may with advantage be tried. The constant, alternating, or sinusoidal current of alternating dynamo.

Though reaction of degeneration is present in a paralysed muscle and therefore there is no response to the faradic current, yet an induction coil current is of undoubted service. It is stated that very strong currents have a harmful effect on feebly contracting paralysed muscles, and should on no account be employed.

The constant current has the greater electrolytic and electrotonic action, whilst the interrupted current acts chiefly on the paralysed muscles by means of its trophic and stimulating effects, directly and reflexly, and also by exerting a wholesome influence on the vasomotor system. The sinusoidal current is more advantageous than the induction coil current on account of the greater magnitude of current that can be borne and the greater smoothness of alternation.

General electrification carried out by means of/

of the electric bath exerts a very powerful trophic influence on the body, and the hot water which acts as the electrolyte, aids in elimination, and by moistening the skin uniformly and thoroughly, lowers its resistance and favours the comfortable passage of the current.

ELECTRICAL REACTIONS.

Case I., Ellen D., Age 24 — Before Treatment.

Muscles	RIGHT				LEFT.		
	Induction Coil.	Battery Milliamperes KCC.	ACC.		Induction Coil.	Battery Milliamperes KCC.	ACC.
Triceps	Natural	3	5	×	Natural	3	5
Supinator longus ×	Decreased, but not lost	3	2	×	Decreased, but not lost	2.5	3.5
Supinator brevis +	No contraction	2.5	1.5	×	"	2.5	3.5
Ext.Carpi.rad.long +	"	2.5	1.5	×	"	2.	3.
Ext.Carpi rad.brev. +	"	2.5	1.5	×	"	2.	3.
Ext.Carpi ulnaris +	"	2.	1.25	+	No contraction	3.5	2.
Ext. comm. digit. +	"	2.	.7	+	"	3.5	2.
Ext.ossis metac.pol. +	"	1.5	1.	×	Slight contraction	2.	3.
Ext. longus poll. +	"	1.5	1.	+	No contraction	1.5	1.
Ext. brevis poll. +	"	1.5	.5	×	Slight contraction	2.	1.
Ext. indicis +	"	1.5	.5	+	No contraction	2.	1.5
Ext.minimi digiti +	"	1.5	.8	+	"	2.	1.5

Remarks: The contractions of all the above muscles (with the exception of the triceps) to the battery current were sluggish.
After three months' treatment, no muscle showed the reaction of degeneration, KCC. appeared with three milliamperes and ACC. with five.
The treatment consisted in electric baths (continuous current) for 15 minutes daily, till all painful neuritis had disappeared, after which she had the application of the sinusoidal current generally by means of the electric bath and locally in the arm bath on alternate days for 15 minutes. A daily labile faradic current was applied to the affected muscles for 10 minutes (negative pole)
Muscles marked + showed complete reaction of degeneration.
" " × " partial " " "

Case II., Ernest F., Age 27. Before Treatment

Muscles	RIGHT				LEFT			
		Induction Coil.	Battery Milliamperes KCC.	ACC.		Induction Coil	Battery Milliamperes KCC.	ACC.
Triceps.		Natural	3.	5.		Natural	4.	5.5
Supinator longus		"	3.	5.		"	3.	5.
Supinator brevis		"	3.	5.		"	3.	5.
Ext.carp.rad.long.		"	3.5	5.		"	3.5	5.
Ext.carp.rad.brev.		"	3.5	5.		"	3.5	5.
Ext.carpi ulnaris		"	4.	5.5		"	3.	5.
Ext. comm. digit.	+	none	3.	1.5	+	none	2.75	1.
Ext.oss.metac.poll.	+	"	2.	1.		natural	3.	4.5
Ext.long.poll.	+	"	2.	.75		"	3.5	5.5
Ext.brev.poll.	+	"	2.	1.		"	3.5	5.5
Ext.indicis	×	Diminished	2.	3.		"	3.	5.
Ext.minimi digiti		Normal	2.5	4.5		"	3.	5.

Remarks: Contraction to galvanic current sluggish in those muscles showing partial or complete reaction to degeneration.

In this case only sinusoidal currents, generally and locally, were given for three months.

Subsequent testing found all the muscles reacting normally to induction and battery currents, and the milliamperage necessary to produce muscular contraction the same as in Case I.

Case III., Joseph B., Age 42.

Muscles		Before Treatment RIGHT. Induction Coil.	Battery Milliamperes KCC.	ACC.		After Treatment. RIGHT. Induction Coil.	Battery Milliamperes KCC.	ACC.
Triceps		Natural	3	4.		Natural	3.	4.5
Supinator longus		"	3.5	4.5		"	3.	4.5
Supinator brevis		"	3.	4.5		"	3.	4.5
Ext.Carp.rad.long.		"	3.	5.		"	3.	5.
Ext.carp.rad.brev.		"	3.	5.		"	3.	5.
Ext.carpi ulnaris	x	Diminished	4.5	3.25		"	3.	4.
Ext. comm. digit.	+	None	3.5	2.	+	None	4.5	4.
Ext.oss.metac.poll.	+	"	3.	2.5	+	"	4	3.5
Ext.long.poll.	+	"	3.5	2.5	+	"	4	3.5
Ext.brev.poll.	+	"	3.5	2.5	+	"	4	3.5
Ext.indicis	x	Diminished	4.	3.	x	Diminished	5	4.
Ext.minimi digiti		Normal	3.	4.		Normal	3	4.

Remarks: Left Arm normal.

As neuritic pain was to a certain extent present, the continuous current was first employed, followed later by general and local sinusoidal current, with direct stimulation of muscles with faradic current for a period of three months.

Extensor carpi ulnaris completely recovered; the other affected muscles still showed the reaction of degeneration.

Case IV., Elizabeth H., Age 53. Before Treatment.

Muscles	RIGHT.				LEFT.			
		Induction Coil.	Battery Milliamperes KCC.	ACC.		Induction Coil.	Battery Milliamperes KCC.	ACC.
Triceps		Natural	1.5	3.		Natural	1.75	3.
Sup. Longus		"	1.25	2.25		"	2.	2.5
Sup. brevis	X	Diminished	3.	2.	X	Diminished	2.	3.
Ext.carp.rad.long.	X	"	3.	2.25	X	"	2.	3.
Ext.carp.rad.brev.	X	"	2.	1.5	X	"	2.	3.
Ext.carp.ulnaris	X	"	2.	2.5	X	"	2.	3.5
Ext.comm.digit.	+	None	1.25	.75	+	None	1.75	1.5
Ext.oss.metac.poll.	X	Diminished	1.	.5	X	Diminished	1.	2.
Ext.long.poll.	X	"	.75	.5	X	"	1.	2.
Ext.brev.poll.	X	"	.75	.5	X	"	1.	1.5
Ext.indicis	X	"	1.	.75	X	"	1.75	1.
Ext.minimi digit.	X	"	1.	.75	+	None	1.75	1.5

Remarks: The patient was only under observation for two months, and thus only had treatment for this time.

Case IV., Elizabeth H., Age 53. After Treatment.

Muscles	RIGHT.				LEFT.			
		Induction Coil	Battery Milliamperes KCC.	ACC.		Induction Coil.	Battery Milliamperes KCC.	ACC.
Triceps		Natural	2.75	4.		Natural	3.	4.
Sup. Longus		"	2.50	3.5		"	3.	4.
Sup. brevis	X	Diminished	3.	3.5	X	Diminished	3.25	3.75
Ext.carp.rad.long.	X	"	2.5	3.5	X	"	3.	4.
Ext.carp.rad.brev.	X	"	2.5	3.75	X	"	3.	4.
Ext.carp. ulnaris	X	"	3.	4.	X	"	3.25	4.
Ext.comm.digit.	X	Slight	2.25	1.75	X	Slight	2.75	2.5
Ext.oss.metac.poll.	X	"	2.5	1.5	X	Diminished	2.	3.
Ext.long.poll.	X	"	1.25	1.	X	"	1.75	3.
Ext.brev.poll.	X	"	2.5	1.75	X	"	2.	3.
Ext. indicis	X	Very slight	2.25	1.5	X	Slight	2.	2.5
Ext. minimi digit.	X	"	2.5	1.25	X	"	1.25	2.

Remarks: The contractions to galvanic stimulation were still sluggish.

This patient had for the first six weeks only the continuous current, owing to the acute stage of the neuritis (general and local electrification.) Subsequently for a fortnight had the induced current directly applied to the muscles, and also sinusoidal currents generally and locally.

The slow recovery depicted above may be partly due to the patient's age.

The testing of the sensory nerves shewed marked improvement after treatment.

The distance between the two coils of a sledge coil was carefully measured for the first appearance of sensibility and also of pain to the current.

In all the cases, except where anaesthesia was very profound, as in Case I., sensation was much improved.

A Short Summary of the Cases after Treatment.

Ellen D.

Has no signs of neuritis now; no pain on pressure over the vagi.

Grubler's tumour, which was much in evidence, is now absent.

Complete hyperextension of both wrists now possible, even against considerable opposing force.

The action of all muscles in both forearms is normal.

There is no disturbance of vaso-motor functions, or any appearance of localised wasting.

Circular measurement of the forearm six inches from styloid process of ulna:

Left side = 9 inches.
Right side = 9½ inches.

Skin/

Skin and tendon reflexes are not acitve, but perceptible.

Dynamometrical measurement shows 28 with the right hand, and 30 with the left.

There are no abnormal sensations present, and sensibility to touch as proved by the aesthesiometer is normal.

Analgesia is still profound over areas supplied by both cutaneous branches of the musculospiral nerve and radial nerve, and the rate of conduction of sensory impulses is delayed.

Ernest F.

The blue line is now absent. Slight tremor of both arms is still present when held in front of the patient. Extensory movements everywhere perfect. No neuritis evident.

Reflexes normal; nor is there any sign of local perspirations.

Dynamometer now registers 55 in right hand, 50 in left. Sensibility to touch, normal.

Measurement of forearm (3 inches from styloid process)

Right side = 7 inches.

Left side = 6½ inches.

Joseph/

Joseph B.

No presence of blue line, no vagal pain. Hyperextension of wrist now possible even against pressure.

The index finger can be partially extended; middle and ring fingers can, on extension, lie in a line with the forearm. The little finger can be hyperextended.

Action of extensor communis digitorum is powerful at the wrist, though hyperextension of the middle and ring fingers not possible.

Action of extensor indicis still defective. Some tremor still remains.

Measurement of forearm (6 inches above styloid process of ulna)

Right side - $8\frac{1}{2}$ inches.

Left side = $8\frac{1}{2}$ inches.

Superficial and deep reflexes still diminished on the right side. No vasomotor disturbance. Dynamometer shews 15 with right, 40 with left. Still some diminution of sensibility to touch, and the rate of conduction is a little delayed.

Elizabeth H./

Elizabeth H.

Pupils now normal. No tenderness on pressure of vagi. Some general tremor still present. There is no improvement in extensory movements of wrists and fingers; reflexes as before. Grubler's tumour absent. Dynamometer reads 15 in each hand. Still some deficiency in sensibility to touch, and hyperaesthesia of skin.

Measurement of forearms - 6½ inches in each case.

Motor power in legs normal, no hyperaesthesia of skin of legs. No tenderness on grasping calf muscles, while reflexes are normal, (showing lower extremities have recovered quicker than the upper.)

The prognosis of the two latter cases must of necessity be guarded.

From the age of the patients, much less permanent improvement must be expected than in the two former cases where, though (especially in Case I.) the paralysis was profound, recovery was rapid under vigorous treatment. If at the end of three months there is no marked improvement, the future outlook is not hopeful. The patient must be warned not to return to his work in "the lead" as relapses are very liable.

During/

During the electrical treatment, the drugs sometimes prescribed in such cases, namely strychnine and the iodide of potassium were omitted, to note the relative value of electricity as a restorative.

Before treatment, the urine was examined for the presence of lead, none was found; again it was tested a week subsequent to the commencement of electrical applications, and in Case II. a perceptible trace of lead was found in the urine by Abram's method, showing the eliminating power of electricity.

The electrodes of the baths were examined for any deposit of lead, but without result.

Melsens first recommended iodide of potassium in lead poisoning, and gave it, with the object of causing lead compounds to become soluble, and thus reabsorbed they were rendered easy of elimination. When large doses of it have been given, symptoms have increased in severity, and sudden death has taken place, due to the rapid entrance into the blood of a large amount of soluble lead salt, which had been previously insoluble and inert in definite combinations with organic matter. Dixon Mann states that iodide of potassium has no appreciable influence on the elimination of lead.

From a study of Lead Paralysis, the following facts suggest themselves to me

1. That the element of fatigue plays a considerable part in its production.

2. That sensory symptoms seem to be far more commonly present than is generally supposed, and that the severity of prodromal sensations bears a definite relation to the extent of subsequent hyperaesthesia or anaesthesia.

3. That where recovery is going to take place, electrical treatment alone is sufficient to bring it about.

4. That the lesion may in certain cases be primarily central.

5. That a reason why the right side is generally sooner and more seriously affected than the left is on account of the greater instability of the higher developed left side of the brain.

6. That the earlier recovery of muscle than nerve is due to its greater vascularity.

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